Appendix C

Science Panel Executive Summary

State of California **The Resources Agency**

M e m o r a n d u m

Date: April 14, 2006

To: Dave Mraz, Acting Principal Engineer
Delta-Suisun Marsh Office
Division of Flood Management

From: Gwen Knittweis, Senior Engineer
North Delta Program
Division of Flood Management

Subject: North Delta Science Panel

Attached are documents summarizing the four North Delta Science Panel (NDSP) meetings held in November, 2003; April, 2004; December, 2004; and January, 2005. The NDSP is comprised of scientific experts in a diversity of fields including hydraulics/hydrology, water quality, and terrestrial and aquatic ecology. The NDSP was convened to provide recommendations to DWR staff on the scientific efficacy of proposed alternatives to enhance ecosystems for the North Delta. The advisory role of the science panel is not intended to influence planning or policy decisions made in future DWR North Delta ecosystem restoration efforts.

The first two science panel meetings focused on providing feedback on McCormack-Williamson Tract (M-W Tract) project elements on or adjacent to Staten Island. The latter two meetings focused on providing feedback on Grizzly Slough elements. The NDSP feedback from the first two meetings, which focused largely on the M-W Tract and environs, was positive and the panel acknowledged DWR staff's difficult task in implementing a complex restoration project. Panel members also recognized the "enormous potential to implement a cutting edge science based restoration project without negatively affecting existing local or regional ecosystem values". However, the NDSP commented that DWR staff need to develop different approaches to meet the goal of ecosystem restoration and flood control. The development of alternatives should be hypothesis based and these hypotheses should be testable and form part of the Adaptive Management program. Subsequently, three ecological models and an alternative covering setback levees were developed by DWR staff.

The second NDSP was organized into three different subgroups at the beginning of the panel meeting; (1) Hydraulics/Hydrology and Geomorphology, (2) Mercury, Carbon, Water Quality, and (3) Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes. Each of these breakout groups summarized their key findings to the larger panel and a quick synopsis of each of the three is described below:

1.) Hydraulics/Hydrology and Geomorphology
Sediment is the limiting resource in the M-W Tract and restoration efforts should focus on maximizing flood flows that capture sediment in order to raise the elevation of the subsided portion of the M-W Tract. In addition, the restoration program should recognize the dynamic nature of fluvial and tidal contributions to the sedimentation

processes. The ultimate goal is the development of a self-sustaining ecosystem which maximizes sediment deposition on the island.

2.) Mercury, Carbon, Water Quality
The absence of information on Mercury (Hg), dissolved organic carbon (DOC), pesticides, and other water quality concerns precludes the implementation of any mitigation efforts. Additional data must be collected to evaluate the impacts of environmental factors such as physical transport processes, pollutant cycling, tidal cycles, seasonable variability, etc., on DOC concentrations and mercury methylation. The panel recommends that a water quality monitoring study focusing on mercury methylation and dissolved organic carbon be conducted to gain a better understanding of how each contaminant functions in a variety of habitats.

3.) Terrestrial and Aquatic Ecology
This subgroup stated that the overall restoration goal for the M-W Tract is to maximize development of habitat that favors native fish and bird species, and discourages exotic species and mosquitoes. Tidal and fluvial scenarios were evaluated for their impacts in achieving the restoration goal. In the case of the fluvial scenario, the sub panel recommended the M-W Tract: 1) “create habitat that is dry in summer and connected to the river and adjacent sloughs during the winter, 2) create patches of terrestrial habitat with successional riparian forests managed through plantings (reinforced levees around M-W Tract would be good for birds), and 3) discourage exotics.” The sub panel commented that the tidal scenario would be much more difficult to implement because creation of a freshwater tidal marsh would likely require extensive maintenance and this type of habitat would promote establishment of exotic species.

There were multiple issues identified by the panel subgroups that may be addressed through adaptive monitoring and management programs. However the goals of (1) converting the M-W Tract to a self-sustaining freshwater tidal wetland and (2) improving sedimentation of the M-W Tract may conflict with the goal of discouraging exotics and mosquitoes. The panel recommended these issues be addressed by clarifying the goals and priorities of the M-W Tract restoration project.

The third and fourth meetings of the NDSP (January, 2005) focused on Grizzly Slough. The panel recommended that a sustainable ecosystem restoration of Grizzly Slough Tract is most suited to fluvial-riparian habitat. Tidal freshwater habitat was considered but was determined to be impractical without significant physical modification to the site. The NDSP concluded the distance from the site to the Delta was too far to have much of a tidal influence.

A more detailed description of the all above listed panel subgroup recommendations is available in Attachments 1 and 2. Attachment 1 “North Delta Science Panel II, April 2004” includes a summary of the first two meetings provided by the NDSP chair. Attachment 2, “North Delta Science Panel IV” provides a summary of the third and fourth panel meetings. Attachment 3 provides a listing of the NDSD government and university scientists.

Attachment 1

NORTH DELTA SCIENCE PANEL MEETING II, APRIL 2004
Science Panel Summary

Introduction

This document summarizes discussion at the second North Delta Science Panel meeting held in April, 2004 at the University of California, Davis. The goals of the second North Delta Science Panel meeting were to: 1) review new alternatives of the North Delta Improvement Project that optimized alternatives that consider ecosystem restoration separately from flood control; 2) review results of modeling efforts by UC Davis that evaluated alternatives; and 3) to identify overarching questions and remaining uncertainties, and to propose adaptive assessment and management actions.

During the morning session, the panel heard presentations from DWR staff regarding a new set of alternatives to consider and from Dr. Geoffrey Schladow, UC Davis evaluating the results of modeling restoration alternatives using the MIKE 11 model. During the afternoon session, the panel scientists and DWR staff broke into three groups for discipline-focused discussion (subgroup summaries are included as Appendix I, II, and III). Panel members of the breakout groups included:

Hydraulics/Hydrology and Geomorphology:

Jon Burau, Hydrologist, USGS--Hydrology/Hydraulic Modeling*
Bill Fleenor, Research Scientist, UCD--Hydrology/Hydraulic Modeling*
Joan Florsheim, Research Scientist, UCD—Geomorphology, Panel Coordinator*
Jeff Mount, Professor, UCD—Geomorphology, Science Panel Chair*
Denise Reed, Professor, UNO—Geomorphology*
Geoff Schladow, Professor, UCD--Hydrology/Hydraulic Modeling*

Mercury, Carbon, Water Quality:

Randy Dahlgren, Professor, UCD--Water Quality*
Roger Fujii, Research Chemist, USGS--Water Quality*
Mark Marvin-DiPasquale, Microbial Ecologist, USGS—Mercury*

Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes:

Lars Anderson, Research Scientist, UCD—Exotics*
Bill Bennett, Research Scientist, UCD--Fish/Aquatic Biology*
Sharon Lawler, Professor, UCD—Mosquitoes*
Peter Moyle, Professor, UCD--Fish/Aquatic Biology*
Dennis Murphy, Research Scientist, UNR--Ecology

*members in attendance for April 7th meeting

At the end of the day, each panel sub-group summarized their key findings to the whole group. A summary of the presentations and breakout group discussion follows. Finally this document identifies conflicting recommendations needing resolution.

Summary of MIKE-11 Modeling Presentation

Presentation by G. Schladow

MIKE 11 is a one-dimensional unsteady model that simulates stage in rivers and the rate at which water flows into off-channel areas. MIKE 11 does not model sediment or sand deposition on floodplains. The model for the North Delta and Cosumnes River has been developed through three Masters theses (Blake, 2001; Hammersmark, 2002; and Moughamian, in progress) and validated using hydrologic records of peak discharges during 1986 (41,285 cfs; ~25 yr RI), 1998 (32,773 cfs; ~10 yr RI), and 2000 (11,791 cfs, ~2.5+ yr RI) at the Michigan Bar gaging station.

Stage gages on the Mokelumne River at Benson's Ferry (upstream) and New Hope Landing (downstream) bracket flow elevations at McCormack-Williamson Tract. Five tracts were flooded during 1986 as a result of levee breaches: Glanville Tract, McCormack-Williamson Tract (Bean Ranch), Dead Horse Island, Tyler Island, and New Hope Tract. The timing of the breaches is evident in the shape of the hydrographs with both Benson's Ferry and New Hope showing a lowering of water surface elevation in the Mokelumne River as a result of the levee breaches. Model simulations show the metering effect of a levee breach at McCormack-Williamson Tract on both the peak discharge and duration of flood flows in the Mokelumne River at both Bensons Ferry and New Hope Landing.

Nine restoration scenarios were modeled as part of Hammersmark's thesis (2002). These scenarios include levee failures upstream and downstream and with a range of options including no action, four breaches, a setback levee, and levee removal. MIKE-11 model results suggest that in all scenarios at the highest flow modeled, there is reduction in stage at Benson's Ferry. In all but two of the scenarios (#6 and #7; Hammersmark, 2002) model results also suggest that there is a reduction in stage or that stage does not vary significantly at New Hope Landing. Interannual variation in tidal datums affects the extent of subtidal, intertidal, and supratidal habitat zones.

These results suggest that it is possible to increase habitat at the McCormack-Williamson Tract without increasing flooding in upstream or downstream reaches—for example, the model predicts no negative impacts of opening McCormack-Williamson Tract to tidal and fluvial flow in an effort to restore ecosystem values. There would be a substantial benefit, however, resulting from filling McCormack-Williamson Tract early during a flood, by eliminating flood hazards associated with the "domino effect," whereby uncontrolled breaching at the upstream end of the tract during a high flow stage releases a flood wave that breaches the downstream end of the tract, and subsequently levees surrounding adjacent Islands and tracts.

Seven new scenarios based on new alternatives developed by DWR were modeled and presented to the Science Panel. These new scenarios model a range of options including levee breaching, secondary channel creation with fluvial and or tidal elements. Additionally, all scenarios share in common one design element – lowering of the eastern levee at McCormack-Williamson Tract to an elevation of 8.5 ft. MIKE 11 model results suggest that at the highest flow modeled, there is a reduction in flow stage in upstream reaches. During this high flow, the model predicts an increase in stage in downstream reaches, due to increased flood conveyance across McCormack-Williamson Tract associated with the lowering of the eastern levee.

Conclusions for old scenarios (modeled as part of Hammersmark's thesis):
- All scenarios reduce water levels at Benson's Ferry, and most scenarios reduce water levels at New Hope;
- Results suggest potential for subtidal, intertidal, and supratidal habitat types – with large variations between scenarios;
- Habitat restoration and flood peak stage reduction at both Benson's Ferry and at New Hope Landing are compatible.

Conclusions for new scenarios (modeled as part of the Science Panel processes to evaluate new alternatives developed by DWR):
- All scenarios reduce water levels at Benson's Ferry (by double the old scenarios), and 10 and 25 yr events increase water levels at New Hope;
- For 10 and 25 yr events, all scenarios yield identical model results;
- Results suggest potential for subtidal, intertidal, and supratidal habitat types – but small variations between scenarios;
- Habitat restoration and flood peak reduction are compatible at Benson's Ferry only;
- The new scenarios all increase peak flood stage at New Hope Landing.

Summary of Hydraulics/Hydrology and Geomorphology Panel Sub-Group

Sediment is currently a fundamental limiting resource in the Delta compounded with subsidence of leveed Delta Islands. Thus, restoration alternatives at MWT should attempt to maximize flood flows that capture sediment in order to raise the elevation of the subsided portion of MWT to the extent possible, and to facilitate the interaction between sedimentation and ecological processes. Sedimentation processes could be enhanced through either fluvial or tidal processes. From a physical processes viewpoint, it is not necessary to separate tidal or fluvial options—both may (and are likely to) coexist from a physical perspective. Recognition of the transitional nature of MWT between fluvial and tidal processes, and accommodating the dynamic nature of both would maximize effectiveness and minimize future maintenance.

Attachment 1

Fluvial Processes (DWR Alternative A: “Secondary Channel”

- Rename DWR Alternative A: a “secondary channel” rather than an “avulsion,” because avulsion implies dynamic switching of channel location, rather than a sand splay and channel complex illustrated in the alternative.
- Restoration strategies should allow for dynamic processes, such as flooding, erosion, and deposition that create and maintain the physical structure of floodplain habitat, rather than simply allowing vegetation growth without the dynamic processes that sustain riparian forest ecology.

The goal of the MWT restoration program should be to initiate a change of trajectory toward a self-sustaining state and capture the maximum amount of sediment on the island. Experience from Cosumnes floodplain restoration efforts suggest that secondary channels will develop as part of sand splay complex formation without excavation of a starter channel. Adaptive management may be needed if flows are insufficient to keep a secondary channel open or if the secondary channel becomes blocked by sand during a flood. If monitoring shows that it is warranted, an excavated secondary channel could be constructed to convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull. Sand (crevasse) splay development at higher overbank stages would enhance floodplain topography as flow is routed from the Mokelumne River into the Tract through an intentional levee breach. Lowering the east levee to 8 ft, would reduce the efficiency of such a breach in focusing flood flow from the Mokelumne River onto McCormack-Williamson Tract.

Tidal Processes

The daily tidal flow may not convey a sufficient volume of sediment to raise the elevation of subsided portions of MWT through deposition of sediment from suspension, although adjacent Snodgrass Slough is apparently accumulating sediment. If tidal flow is introduced to MWT through Snodgrass Slough, and monitoring shows that deposition within the Tract does not occur, an adaptive management option to consider would be a one time only dredging of Snodgrass Slough where material excavated from the slough would be placed in the subtidal portion of MWT to raise elevations to tule colonization elevation (MLLW). Determination of the cause of aggradation in Snodgrass Slough would need to be taken into account along with other environmental factors such as water quality that limit dredging in the Delta.

Attachment 1

Summary of Terrestrial and Aquatic Ecology, Exotic Vegetation, and Mosquitoes Panel Sub-Group

Fluvial Scenario

The goal of restoration alternatives that focus on fluvial processes at MWT is to maximize habitat that optimizes birds, native fishes (splittail and salmonids) and discourages mosquitoes and exotics. This approach should seek to create a self-sustaining floodplain mosaic of riparian habitats. Components of this scenario should include the following:

- Minimize standing water in order to avoid mosquitoes and exotic aquatic plants.
- Monitor and manage exotics, particularly invasive aquatic plants and animals.
- Promote habitat adapts to and keeps up with sea level rise.
- Seek simplicity in design (e.g do not over-engineer) in order to allow systems to self-organize.
- DWR options #3 and #6b have some direct benefits for ecology, but the sub-group expressed concerns over excavating a channel through MWT because it could lead to standing water on site all year (e.g. problems with mosquitoes).
- An optimal management strategy would be to encourage flooding from January through late April – early May, and then drain the restoration area, keeping it dry through the summer. This would discourage exotic aquatic plants and animals and minimize mosquito problems.

To promote native fishes species such as salmon and splittail and an array of other species, the MWT should: 1) create habitat that is dry in summer and connected to the river and adjacent sloughs during the winter; 2) create patches of terrestrial habitat with successional riparian forests managed through plantings (reinforced levees around MWT would be good for birds); 3) discourage exotics.

In the fluvial scenario, water should inundate MWT for short periods of time and then drain. Alternatively, this scenario could include a wetland in lower MWT that is disconnected from the river and sloughs during the summer and fall. This wetland could receive deposition of sediment, with a pond or lake at the downstream end of the island. The subgroup felt that the wetland would not provide significant ecological benefits, but that it also would not be likely to support exotics or mosquitoes.

Tidal Scenario

The sub-group concluded that the negative and positive aspects of tidal wetland restoration at MWT self-cancel. Although establishment of freshwater tidal marsh is a CALFED goal, creation of this habitat on MWT may require extensive maintenance. Major invasions of exotic plants and animals would be expected within this habitat, because of the presence of exotic species proximal to the site. Moreover, the sub-group felt that managing tides to create floodplain habitat doesn't make sense**.** However, should MWT be restored as a tidally-influenced system, the impacts of ponding in the downstream end of MWT will need to be addressed and may require installation of nekton gates similar to those used in Suisun Marsh. The gates which would be used to mute an intertidal range on MWT, may impact the movement of native fish on and off of the island during the winter.

Avoiding problems with standing water, stagnation, mosquitoes, and exotics in the tidal scenario would require drainage and intensive management (management at postage stamp level when problems really are really regional in scope). For example, tides will vary in magnitude and stage and interact with the uneven topography of the island, and may form standing water that is not flushed out during subsequent lower tides. These ponded areas will produce mosquitoes unless they are ditched or leveled, requiring continual monitoring and maintenance. A managed tidal system could reduce mosquitoes and egeria. This would involve limiting tidal exchange between the island and surrounding sloughs and river to the December-early May period. After early May, the island would be drained in order to eliminate any standing water. In the tidal scenario, MWT would be a wet island during the winter when exotics do less damage, and when there are fewer mosquitoes. This system would not function as a tidal marsh after this scenario. It should be noted that mosquito season is likely to lengthen due to predicted climate changes, which may modify the future flood regime.

Summary of Mercury, Dissolved Organic Carbon, and Water Quality Panel Sub-Group

There is a deficit of information on Mercury (Hg), dissolved organic carbon, and other water quality issues in the North Delta; however, within a few years there will be a series of good data sets produced as a result of current research projects. There are numerous critical uncertainties with respect to mercury methylation; however, nothing in present in the current body of knowledge is a "show stopper" with respect to restoration of fluvial or tidal systems. The panel sub-group suggested that the focus of questions that need to be answered change with each alternative for restoration-flood control that DWR proposes.

Specific uncertainties arise from the lack of knowledge about the effects of factors on mercury methylation and dissolved organic carbon. Such factors include: effects of seasonal variability, physical transport processes; pollutant cycling; pollutant functions in various sub-habitats; effects of floods, tidal cycles, temperature, wetting and drying, and submerged aquatic vegetation; interactions with phytoplankton blooms, fish or other aquatic organism's life cycles. Moreover, there is uncertainty about hydrodynamic transport of dissolved organic carbon to water intake pumps in the South Delta, potential for soil absorption, and if there is a difference between what is derived from channels vs. islands. Sediment and pesticides were also identified as pollutants: restoration of McCormack-Williamson Tract would be likely to improve water clarity downstream under most scenarios; and pesticides would be taken up by biota, or degraded on-site.

Monitoring of mercury methylation and dissolved organic carbon should be conducted to help answer questions as to how each pollutant functions within various habitats and sub-habitats is needed. This will help resolve uncertainties with respect to different habitat systems' microbial and nutrient cycles, transport processes, hydrologic and sediment regimes, and grain size distributions. Monitoring over a year/s will allow for identification of intersections by overlaying fish life cycle, floods, erosion and sedimentation, phytoplankton blooms, temperature with rate of mercury methylation, etc. These data could be used as a comparison to other nearby wetlands such as at the Cosumnes River Preserve and provide the basis for a linked sediment transport, hydrologic, mercury methylation, dissolved organic carbon model recommended by the panel.

Issues Needing Resolution

During the course of their discussions, the panel sub-groups identified several critical uncertainties that may be addressed through adaptive monitoring and management programs (see Appendix I-III). However, two issues were identified that result in incompatibilities that need resolution. These are:

1. The goal of initiating a change toward a self-sustaining freshwater tidal wetland relying on both fluvial and tidal processes and interactions conflicts with draining the restoration area and keeping it dry through the summer, in an attempt to minimize standing water, and exotics during the warmer months.

2. Capturing the maximum amount of sediment on MWT requires option such as an intentional levee breach and development of secondary channels in order to maximize sedimentation within the tract. However, the Aquatic Ecology/Exotic Vegetation/ Mosquitoes panel subgroup suggests that excavating a channel through MWT would be a problem if it allowed water to remain on site all year (e.g. problems with mosquitoes).

These issues should be addressed through clarification of goals and priorities for restoration at MWT. Additional issues related to the MWT project's goals and priorities requiring definition are detailed in the: *Summary of Issues Raised by the Science Panel at the November 13, 2003 Meeting* (Appendix IV).

Attachment 1

APPENDIX I

North Delta Science Panel Meeting II April 7, 2004

HYDRAULICS/HYDROLOGY AND GEOMORPHOLOGY

Group Summary:

Sediment is a fundamental limiting resource in delta because of subsidence and reduced supply from upstream. Restoration alternatives should try to maximize flood flows and capture sediment within MWT, and allow for dynamic processes on the floodplain, not simply riparian vegetation.

Recommend calling Alternative A: "secondary channel" rather than an "avulsion."

Experience from Cosumnes floodplain suggests that secondary channel will develop as part of sand splay complex without excavation of a starter channel. Alternatively, an excavated secondary channel could convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull—and sand crevasses at higher overbank stages. Lowering the east levee to 8 ft, would reduce the efficiency of an intentional levee breach in focusing flood flow from the Mokelumne River onto McCormack-Williamson Tract. Adaptive management may be needed if flows are insufficient to keep a secondary channel open or if the secondary channel becomes blocked by sand during a flood. The goal is to initiate a change of trajectory toward a self-sustaining state and capture the maximum amount of sediment on the island.

It is not necessary to separate tidal or fluvial options—both are possible from a physical perspective.

Daily tide doesn't bring in a lot of sediment. Snodgrass Slough is accumulating sediment—so an option is a one time only dredging of Snodgrass slough where material excavated from the slough would be placed in the subtidal portion of MWT to raise elevations to tule colonization elevation (MLLW).

Questions to Address in Group Discussion

1. How can existing sedimentation processes be modified to enhance ecosystem restoration and flood control? What additional efforts can be undertaken to further enhance our understanding of the sedimentation processes.

Attachment 1

Critical uncertainties:

- Sediment supply (mean annual ~440 tons/day – highly pulsed) and rates of sedimentation within MWT;
- Sediment quality (type or grain size);
- How sensitive is flood conveyance to the elevation of the eastern levee? Higher increases sediment input to island.

Adaptive Management/Experiments Needed to Address this:

Regional examination of sedimentation patterns (long-term sediment budget) – identify tradeoffs.

Concerns or recommended modifications to design:

- Use vegetation to enhance sedimentation, OM will enhance aggregation and sediment;
- Dredging Snodgrass may increase flood control, and use sediment for subtidal;
- Sand splay complex near upstream levee breach enhances topographic variation;
- Raise 8.5 ft eastern levee to get more water and sediment directly into MWT via the secondary channel.

2. What adaptive management measures might be important to incorporate into the project regarding hydraulics/hydrology, and geomorphology?

- Narrowest possible acceptable breach width (tidal or riverine), enlarge as necessary (OK if it enlarges by itself);
- Adaptive management controlled releases from upstream dams – to assist channel incision, sediment effects are likely to be marginal but should be tried;
- Try controlled breaches on tidal channels;
- Construct and maintain a 3-d model (water, sediment, and WQ) to test CM and apply results in AM framework;
- Monitoring geomorphic changes;
- Monitor this project as an experiment for future work.

3. What local geomorphic process might occur within McCormack-Williamson Tract under the different scenarios

Riverine/floodplain

- Degrading levee – sedimentation;
- Focused breaches – new channels, deposition, crevasse splays;
- Interior channel – would meander, deposit point bars, evolve to complex forms;

Tidal

- Tidal channels – low order dendritic channels;
- Ponds within vegetated marsh;
- Sedimentation within vegetated areas.

4. Can McCormack-Williamson Tract support dendritic tidal channels?

Critical uncertainties:

Will they wash out? (especially with the east levee degraded)

- Depends on time scales for development of channels vs frequency/magnitude of floods.

Tidal range locally is lower than in other parts of delta – is it enough?

- There will be channels within the marsh on the intertidal but they may not be very complex given small size of area and tidal range.

Adaptive Management/Experiments Needed to Address this:

- Could plug/re-grade drainage ditches in one area, and not in another;
- Could re-grade/till surfaces to make erosion of channels more likely in one area vs. another;
- Staged implementation – let tules develop first, then degrade the levees.

Concerns or recommended modifications to design:

- Removal of material from intertidal/subtidal is counterproductive to the development of tidal channels. No need to dig starter channels;
- Protection of interior levees from wave action may only be a concern until marshes develop (tules absorb wave energy);
- Tule planting could really kick-start sediment deposition.

5. How would opening McCormack-Williamson Tract to increased flood conveyance affect upstream and downstream areas geomorphologically?

Critical uncertainties:

- No data but CMs cover this issue.

Adaptive Management/Experiments Needed to Address this:

- Monitoring.

Concerns or recommended modifications to design:

- Alongside MWT rate of incision will decrease;
- Nothing happens upstream and downstream.

6. How would a (natural or manmade) avulsed channel through McCormack-Williamson Tract affect flooding and sediment deposition on the Tract as well as upstream and downstream from a geomorphic viewpoint? *refer to info on #7 Upstream and downstream effects*

Critical uncertainties:

- Where does the sediment we want to capture on MWT go now?

Adaptive Management/Experiments Needed to Address this:
- Monitor changes in sediment deposition in South Fork.

Concerns or recommended modifications to design:
- Cosumnes experience is scour on upstream side, deposition on downstream side.

7. What are the tradeoffs with either letting the channel naturally avulse through McCormack-Williamson Tract, constructing a channel (or a portion of a channel) through the Tract?

Critical uncertainties:
- Crevasses vs. channel avulsion uncertain? Natural avulsion usually produced by blockage/inefficiency of main channel.
- Will new channel cut into the existing substrate? Is starter channel needed?

Adaptive Management/Experiments Needed to Address this:
- Try experiment of cutting channel and seeing if natural flows can keep it open.

Concerns or recommended modifications to design:
- "Avulsion" means actually moving the channel – this may not be feasible in near term.
- What we really should call this scenario is creation of a "secondary channel" as part of an anastomosing (multiple channel) system.
- Experience from Cosumnes floodplain suggests that secondary channel will develop as part of sand splay complex without excavation of a starter channel;
- Alternatively, an excavated secondary channel could convey streamflow, sediment and momentum to downstream portions of MWT during increased stages that are still below bankfull—and sand crevasses at higher overbank stages;
- If a pilot channel is excavated, material should be used to fill lower parts of MWT (e.g. make some subtidal areas intertidal);
- Breach levee at the highest elevation part of island to increase channel cutting efficiency;
- In order to encourage more flow into the new channel increase elevation of east levee above 8.5;
- Do not armor the breach or the channel; let natural levees develop along channel.

8. Would it be ecologically feasible to construct a tidal marsh plain with imported material in the southern subtidal McCormack-Williamson Tract upon which intertidal channels might form? Would these channel systems be sustainable?

Critical uncertainties:

- Same uncertainties as #4 re. tidal channel formation;

Adaptive Management/Experiments Needed to Address this:
- Try opening first and letting tides move sediments around to produce land forms;
- Work with DCC to maximize sediment inputs.

Concerns or recommended modifications to design:
- Natural process solutions are preferred;
- One time only - dredge Snodgrass Slough and use material to fill downstream subtidal end of MWT to tule colonization elevation (MLLW).

Attachment 1

APPENDIX II

North Delta Science Panel Meeting II April 7, 2004

TERRESTRIAL AND AQUATIC ECOLOGY, EXOTIC VEGETATION AND MOSQUITOES

Group Summary:

Fluvial Scenario
Maximize habitat that optimizes birds, native fishes (splittail and salmonids) and discourages mosquitoes and exotics: floodplain mosaic of riparian habitats.

- Minimize standing water.
- Monitor and manage exotics.
- Design should promote habitat that keeps up with sea level rise.
- In this scenario, the goal is simplicity (e.g simple topography and flood regime).
- Options #3 and #6b have some benefits for ecology – but group had problems with excavating a channel through MWT because it would be a problem to have water on site all year (e.g. problems with mosquitoes).
- An optimal as management strategy would be to have flooding from January from April - May and then drain the restoration area, keeping it dry through the summer.

To promote native fishes species, e.g. salmon and splittail and an array of other species; 1) create habitat that is dry in summer and wet in winter; 2) create patches of terrestrial habitat with succession of riparian forest managed through plantings (reinforced levees around mw tract would be good for birds); 3) discourage exotics.

In the fluvial scenario, water would inundate MWT for short periods of time and then drain—or this scenario could include a wetland in lower MW. This could get some deposition of sediment, with a pond or lake at downstream end of the island that would hold water that wouldn't go through gate. May have no benefits, but wouldn't have hazards-exotics, mosquitoes.

Tidal Scenario
The negative and positive aspects of tidal wetland restoration at MWT cancel each other out, as there is a risk of not being able to create habitat that wouldn't require a lot of

maintenance. Major invasions of exotics would be expected. Moreover, managing tides to create floodplain habitat doesn't make sense**.** Some problems could occur, e.g. how would fish get into island in muted regime at gates? It makes more sense to create a floodplain system instead of a tidal system and not use nekton gates.

However, a strategy for a tidal scenario would need to recognize that there would be ponding in the downstream end of MWT. To address the standing water, a nekton gate could be installed (e.g. at Suisun Marsh, a nekton gate allows muted tidal range and control mechanisms to full drain and then partial fill). This could create a muted intertidal range. .

Avoiding problems with standing water, stagnation, mosquitoes, and exotics in the tidal scenario would require drainage and intensive management (management at postage stamp level when problems are really regional), e.g. if tidal action creates berms that pools water. Tides also vary in height and the landscape is uneven, so it is likely that other pools will form in low areas during higher tides. These will not flush out on subsequent lower tide cycles. These ponded areas will produce mosquitoes unless they are ditched or leveled. The ditches will require maintenance.

In tidal scenario managed for mosquitoes and egeria:

- Tides and floods would be allowed all winter long (December to ~May), but close off after late April – May time frame.

- Tidal system would be opened to floods and tidal flow during cold part of year

- System wouldn't function as a marsh since it would be kept dry part of year.

In the tidal scenario, MWT would be a wet island during the winter when exotics do less damage, and when there are fewer mosquitoes. Mosquito season is likely to lengthen due to global warming.

<u>Questions to Address in Group Discussion</u>

1. Can McCormack-Williamson Tract support dendritic intertidal channels?

Critical uncertainties:

a) Do dendritic intertidal channels improve conditions for invasive species?
b) Can dendritic intertidal channels deep out egeria and other marsh exotics?
c) How do flow rates influence mosquito populations?
d) Could a managed marsh be a major exporter of carbon to the rest of the system?
e) Will a "ditched" dendritic system work from draining marshes and not create habitat for exotic fishes?

a-d above may not be essential for restoration – if draining standing water is important for mosquito control, then dendritic ditches (no standing water) may be needed).

Adaptive Management/Experiments Needed to Address this:
Create region that is dry in the summer and wet in January – April (low risk-high benefit)
 Have gates that could operate experimentally to see affect on Hg, exotics, natives
 Nekton gates to keep water flowing out of system (no standing water)
Artificial channel creation

Concerns or recommended modifications to design:

a) Must keep water moving through the system
b) Can control (management) at "postage stamp" (e.g. MWT in relation to the Delta) level make a difference? Issues are Delta-wide; is this an "experimental" island?
c) Can the designs keep up with sea level rise?

2. How might increasing the flood frequency on McCormack-Williamson Tract affect exotic species in the different proposed restoration alternatives?

Frequency is not as important as other variables!

Critical uncertainties:

1) What do different intensities of flooding do to exotic plants and other biota?
2) Flood frequency is not as important as duration of flooding and timing.
3) How much duration of subtidal habitat is needed to promote native fishes?
4) How much flooding before exotic plants establish? How do you keep unwanted organisms out when breaches are opened in January and February? Is it possible?

3. Which of the proposed restoration alternatives are most beneficial to native fish in the North Delta region? Other species?

Critical uncertainties:

1. How much variability in flooding is needed?
2. What kind of aquatic habitat, if any, is maintained through dry season without harming native fish?
3. What kind of terrestrial habitat can/should be created to benefit terrestrial species of concern?
4. Can excavation create diversity (or just more uncertainty)?
5. Is channel excavation even a good idea? Would it capture the Mokelumne? Probably not) What are groundwater table effects?

Assumption is that all (wildlife friendly) levees must be re-sloped on inside (8 miles) of site to support riparian forest. Will the material required be brought in from off-site or will it be excavated from on-site?

Attachment 1

Adaptive Management/Experiments Needed to Address this:
a) Need to set goals! What do we need to maximize?
1) Splittail spawning and rearing, chinook rearing.
2) Riparian forest in multiple successional stages (make patches).
3) Discourage exotics.

Concerns or recommended modifications to design:
For splittail and chinook (and to minimize for mosquitoes and exotic plants):
#3 Breaches and Nekton gate
#6b Breaches and Nekton gate + subsidence recovery (eliminates open water habitat)

For other species:
#1 secondary channel scenario
#7ab good for birds (channel dugout for levees)
could channel be seasonal?
Would you hit groundwater and get stagnant pools?

Simpler topography an flooding regime is probably better (more manageable) – let processes create their own heterogeneity.

4. Can the proposed restoration alternatives be modified to discourage exotic species' establishment (such as submerged aquatic vegetation, exotic fish) in McCormack-Williamson Tract? What control measures should be adopted as part of the project?

Critical uncertainties:
Will short duration flooding keep out exotics?
Can public education reduce spread of exotics?

Adaptive Management/Experiments Needed to Address this:
Flooding during winter, dry during summer.
Re-vegetate with native plants, monitor for exotics.

5. Which of the proposed restoration alternatives present the greatest risk of harmful mosquito production? Can the alternatives be modified to reduce the risk of mosquito problems?

Critical uncertainties:
Mosquito season expanding with global warming;

Concerns or recommended modifications to design:
Be sure marshes drain;
Limit standing water;
Winter flood/summer dry good;

Access needed for abatement people.

6. What mosquito control measures should be adopted as part of the project?

Critical uncertainties:
Can access be created if needed?

Concerns or recommended modifications to design:
If water off early—not much of a problem.

7. What adaptive management measures might be important to incorporate into the project regarding terrestrial and aquatic ecology, exotic vegetation, and mosquitoes?

Monitor and control as needed, reconfigure habitat to discourage these species if needed.

Critical uncertainties:
Unintentional natural habitats will form.

Attachment 1

APPENDIX III

North Delta Science Panel Meeting II April 7, 2004

MERCURY, DISSOLVED ORGANIC CARBON, AND WATER QUALITY

I. Mercury (Hg)

Many critical uncertainties related to Hg cycling and dynamics were identified that make it difficult to assess which proposed restoration alternatives for MWT have the greatest risk for Hg methylation and uptake by the foodweb.

General Critical Uncertainties With Respect to Hg

1. Methylation of Hg depends on several factors such as the presence of sulfate and redox conditions conducive to microbial reduction of sulfate (sulfate reducing bacteria also methylate Hg), quantity and quality of dissolved organic carbon (DOC can bind Hg and increase total Hg in solution thereby affecting potential availability of Hg for methylation), and DOC quantity and quality, in addition to other factors (e.g., temperature), also may influence the rate and extent of Hg methylation. Therefore, understanding the relative contribution of these types of multiple controls on Hg-methylation under the biogeochemical conditions at various anticipated sub-habitats (SAV, marsh, open-water, sloughs, vs river channel) are key critical unknowns that cause large uncertainties when trying to assess which restoration alternatives will likely have the greatest risk for Hg methylation.
2. The size and configuration of levee breaches will affect the tidal prism, which will determine the relative and absolute amounts of subtidal, intertidal, and supertidal zones. The resulting habitats (big unknown) will have a significant effect on Hg cycling because of the very different biogeochemical environments associated with these habitats.
3. The variations in hydrology (big unknown), as a result of various restoration scenarios, will influence suspended sediment particle size distribution within MWT, which will impact a) Hg distribution, b) redox gradients, c) Hg/MeHg diffusion rates across the sediment water interface.
4. We currently have a very poor understanding of the physical and chemical processes that transport Hg from the sediment to the water column.
5. Transfer of Hg(II)/MeHg from the water column into the base of the food web (i.e. phytoplankton and benthic fauna) also is unknown.
6. The effects of seasonal variability Hg cycling and transport processes currently are very poorly understood.
7. Under the various proposed restoration scenarios for MWT, we need to gain an understanding of the temporal interaction between macro-biological cycles (e.g. algae, fish, etc.) and MeHg production and degradation and transport.

8. We need to determine the influence that SAV (e.g., eugaria) and emergent marsh plants (e.g., tule), have on a) sediment trapping, b) *in-situ* organic matter production, and c) rhizosphere – redox chemistry, all of which ultimately affect Hg-cycling.

II. DOC (and other Water Quality Concerns)

Dissolved organic carbon (DOC) plays two important roles of concern for restoration of MWT: DOC can be important in Hg cycling (discussed above) - as an energy source for microbial methylators and as a ligand that complexes Hg and increases total Hg in solution; and as a precursor to disinfection byproducts (DBPs) (e.g., trihalomethanes) that form when water containing certain forms of DOC is chlorinated for drinking water. The primary drinking water quality concern is whether and how much the proposed restoration scenarios will increase the loads of DOC, and more particularly DBP precursors, in water discharged from the restoration site that eventually reach any of the drinking water intakes in the Delta.

General Critical Uncertainties With Respect to DOC

1. The quality and quantity of DOC (DBP precursors) derived from different land uses (e.g., floodplain, agriculture, wetland) and discharged to the channel water need to be assessed to determine whether restoration activities that alter the land use patterns will result in increased discharge of DBP precursors.
2. The hydrodynamic transport of DOC to the drinking water intakes.
3. The (photo) and biological degradation and bioavailability of DOC transported to the drinking water intakes.
4. Combination of #1, 2, and 3, determine the forms of DOC produced by restoration activities, the residence time in channel waters before reaching the intake pumps, and the potential for degradation and consumption for DOC precursors. These (unknowns) together will determine whether the DOC produced from restoration activities will pose a significant drinking water problem.
5. Will pesticides be degraded or taken up as a result of restoration?
6. Will the MWT restoration improve water clarity downstream as a result of particle trapping, thereby increasing potential for primary productivity?

III. Adaptive Management / Experiments Needed to Address Hg and DOC Uncertainties:

1. Review and synthesize all existing scientific studies regarding Hg and DOC currently taking place around the MWT, in the Delta, and in other analog environments.
2. Plan to develop a Hg-DOC model for the system, linked to the hydrology and sediment transport model.
3. Paired floodplain studies with the MWT and the Cosumnes, focusing on Hg and DOC.
4. Baseline studies of Hg/MeHg concentrations and DOC quantity and quality in soils and sediments.
5. Linked Hg-MeHg-DOC net flux experiments from the MWT as a function of sub-habitats.

6. Mesocosm studies in and nearby the MWT to investigate Hg-cycling dynamics and effects of DOC quantity and quality.
7. Develop annual cycle conceptual models for key processes (Hg-transformation dynamics, phytoplankton blooms, hydrology, nutrient cycles, primary consumer and fish life cycles, etc…).
8. Laboratory-based photo and microbial DOC degradation studies on waters collected from habitats representative of those expected to exist in the MWT restoration. Assess changes in DOC quality due to degradation studies, especially with respect to changes in DBP precursor content and changes in DOC-Hg interactions.
9. Compare and contrast DOC quantity and quality from currently existing wetlands: both seasonally flooded areas and diurnally flushed wetlands.
10. Particular attention needs to be focused in areas that are subject to fairly long periods of drying followed by an intense precipitation or irrigation event. Under these conditions, significant "flushing events" for both Hg methylation and DOC production from soils have been observed in the Delta.

Attachment 1

APPENDIX IV

Summary of Issues Raised by the Science Panel at the November 13, 2003 Meeting

Introduction

The University of California, Davis Watershed Center, under contract with The California Nature Conservancy, convened a panel of scientific experts to assist and assess the California Department of Water Resources' North Delta Flood Control and Ecosystem Restoration project (formerly called the North Delta Improvements Project, NDIP). The project seeks to "implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species and ecological processes." A summary of the NDIP and related documentation can be found at http://baydeltaoffice.water.ca.gov/ndelta/northdelta/. The project's Science Panel is charged with evaluating proposed efforts to enhance ecosystems of the North Delta and to recommend alternatives where appropriate.

The goals of the first meeting were to review the status of the North Delta Improvement Project and to evaluate DWR's efforts to meet the project's ecosystem objectives. During the morning the panel heard presentations from DWR staff on the project. The afternoon was spent interacting with staff on critical hydrologic and ecologic uncertainties and components of the project's design. The final hour of the meeting consisted of panel members only, with no DWR staff in attendance.

The Science Panel is composed of 13 government and university scientists with expertise in a broad range of disciplines. Current members include:

Lars Anderson, Research Scientist, UCD—Exotics*
Bill Bennett, Research Scientist, UCD--Fish/Aquatic Biology*
Jon Burau, Hydrologist, USGS--Hydrology/Hydraulic Modeling*
Randy Dahlgren, Professor, UCD--Water Quality*
Mark Marvin-DiPasquale, Microbial Ecologist, USGS--Mercury
Bill Fleenor, Research Scientist, UCD--Hydrology/Hydraulic Modeling*
Joan Florsheim, Research Scientist, UCD—Geomorphology*
Roger Fujii, Research Chemist, USGS--Water Quality*
Jeff Mount, Professor, UCD—Geomorphology*
Peter Moyle, Professor, UCD--Fish/Aquatic Biology
Dennis Murphy, Research Scientist, UNR--Ecology
Denise Reed, Professor, UNO—Geomorphology*
Geoff Shladow, Professor, UCD--Hydrology/Hydraulic Modeling*

*members in attendance for November 13th meeting
The Panel Chair is Jeff Mount and Panel Coordinator is Joan Florsheim

The following is a summary of comments, conclusions or recommendations made by panel members:

Attachment 1

General Observations

- The panel sees enormous potential to implement a cutting-edge science-based restoration project experiment without negatively affecting existing local or regional ecosystem values. Combinations of the ecosystem restoration and flood hazard reduction goals can, with further exploration, provide a pragmatic approach toward managing the North Delta. The panel looks forward to working with DWR staff to achieve these goals.

- Given the potential of the NDIP, and the expressed intent on the part of DWR to attempt to optimize flood control and ecosystem restoration, the panel felt that it is important that a greater range of alternatives be considered and their relative flood/ecosystem benefits be explicitly stated. This will allow an assessment of trade-offs in project design.

- The panel felt that the overall project is still relatively unformed and there is a lack of specificity about what the project hopes to accomplish. It was difficult for the panel to assess constraints, including political, financial, hydrologic and ecologic, and their rationales. These need to be developed better by DWR staff.

- To date there has been limited reliance on ecosystem science in merging goals, objectives, and alternatives for the project. It is anticipated that the Science Panel will assist in incorporating this into the project. However, design considerations and objectives appear to be driven principally by flood control issues, with ecosystem restoration goals a secondary objective. Rather than driving design, ecological objectives are adjusted to fit into the overall flood control objectives. The panel recognizes that tradeoffs come with making decisions in ecosystem enhancement—e.g. cost effectiveness, flood impacts, etc. DWR needs to explicitly define priorities, however. If DWR is trying to optimize ecosystem restoration and flood control goals it needs to define alternatives that support ecosystem restoration without constrains imposed by flood control.

- One of the stated goals of the project is sustainability. DWR needs to more explicitly define this and to demonstrate relative differences in sustainability of project alternatives. If a goal is to be sustainable, DWR should demonstrate what can be achieved without engineering manipulation and without alternatives that require long-term maintenance.

- If the stakeholder scoping process drove flood control constraints, then other stakeholders with environmental restoration goals besides TNC should be recruited into the scoping process; e.g. resource agencies and other environmental groups. These stakeholders need to be included in an integral way into the modeling and planning process rather than in the currently separate efforts of the agency ecosystem group.

Attachment 1

Panel Recommendations

- Merge principles, goals, objectives and alternatives so that they are evaluated in a consistent manner. For example, the goal of being sustainable is not consistent with elements of some alternatives, such as dredging; the goal of promoting natural disturbances may not be consistent with flood control; the goal of creating dendritic channels may not be appropriate at MWT—because of the potential dominance of fluvial processes. Cross correlate every principle, goal, and objective with each alternative to see if it meets the criteria. This will allow a systematic evaluation and comparison of alternatives.

- Develop alternatives that create sustainable function rather than a particular habitat. In a dynamic fluvial-tidal system like the North Delta, habitat mosaics will evolve with time and may ultimately lead to the disappearance of some habitat types. For example, a design for dendritic channels may not persist due to fluvial disturbances.

- Develop separate alternatives to meet the goal of ecosystem restoration at MWT. For example develop restoration alternatives for MWT that do not significantly change stage in the North Delta system. This will aid in identification of elements that are critical to restoration, without first negating them.

- In order to evaluate alternatives distilled out of this first meeting, a systematic approach needs to be developed to assess ecosystem benefits separate from flood control benefits. Once completed, then the two assessments can be blended to evaluate optimization approaches. This would involve defining projects that maximize each of the following:

    1. Restore sustainable ecosystem function at MWT
        a. without regard to flood control
        b. without increasing flood hazards

    2. Reduce flood hazard upstream of MWT

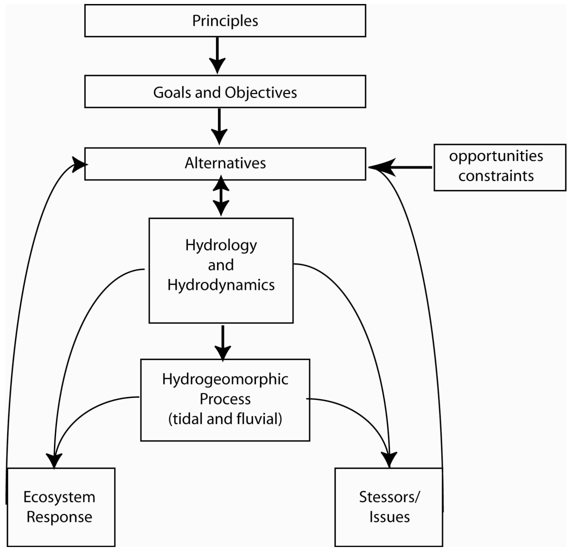
    3. Reduce flood hazard downstream of MWT

    4. Combinations of 1 with 2 and 3

- Use these (new) defined alternatives to develop an adaptive management strategy as the elements of adaptive management must be based on predicted ecosystem response and both science-based ecological and flood metrics.

- Predict ecosystem-response and stressors to each alternative using science-based ecological metrics. The panel recommends developing relationships that can be applied across the alternatives to use as an evaluation tool. The following figure provides an illustration of the recommended process.

Attachment 1



- Develop a matrix to show relative benefit of alternatives—e.g. high, minimum low. Such a matrix may look like this:

Alternative I	Metric	High	Medium	Low
	Metric 1			
	Metric 2			

- In order to achieve the best possible result, the project alternatives need more scientific analysis that addresses the way the project is likely to work, based on analogue and professional literature. In order to accomplish this, the panel recommends analyzing IEP datasets, data from the Yolo Bypass work, and the Cosumnes floodplain work to define and quantify relationships that identify potential physical drivers, trends (not statistical relationships), and pathways leading to ecological response. Uncertainties identified through this process should drive the adaptive management process—where specific hypotheses are posed and tested. In this way, the project may be implemented as an experiment that furthers restoration science. Some of this analysis needs to be iterative, for example to address water quality, food web dynamics, etc., the modeling scenarios need to be defined and output provided.

- It is important that the ecosystem science portion of the project be hypothesis-based. These hypotheses should be testable and form part of the Adaptive Management program. For example: Hypotheses (1) a restored MWT will be dominated by fluvial processes that will, through time, eliminate dendritic channels formed in tidal areas. Alternatively, Hypothesis (2) a restored MWT will develop dendritic tidal channels that will remain tidal.

Attachment 1

- The panel recommended that anticipated ecosystem responses and metrics should be developed by DWR. Many of these will rely on modeling output and field surveys to illustrate specific conditions and further analyze ecosystem response. Multiple models will need to be developed that are not currently available. A selection of these include:

  Links between MWT hydraulics and anticipated geomorphic response;
  Links between hydrogeomorphic processes and riparian forest establishment and growth;
  Links between spring snowmelt flows and native fish use of MWT;
  Biological models that describe predator-prey relationships, presence-absence relationships of particular species

- Example: The approach developed in upstream sand splay complexes at CRP levee breaches can be used to predict the evolution of splay complexes at MWT. If splay complexes are a defined element of the restoration then use a hydrogeomorphic model to predict sand splay evolution, assess available information to define expected relationships and to develop experimental design. If elements are totally unknown, or there are critical uncertainties, then define targeted research.

- Example: project design is currently based on one or two floods. New modeling will be needed evaluate how various (new) restoration alternatives perform under a range of flood and tidal flow conditions. Rather than using one or two "design" flows, modeling should address intra and interannual variation, since ecological responses will be tied to processes at this time scale. This hydrologic modeling should form the foundation for assessment of anticipated ecosystem responses.

- While the development of two independent hydraulic models provides a range of information on the physical components of the North Delta system, the panel has some concerns about the separation of modeling efforts where the HEC-RAS model is developed to address flood control analysis and a MIKE-11 model is developed to address ecological restoration analysis. Now that both models are up and running, the panel recommends running the models side by side, using the same input parameters and boundary conditions to address modeling uncertainty in all of the alternatives. Of particular concern are some of the key hydraulic unknowns in the system that have not been addressed (e.g. the lack of small to moderate flood magnitudes in the flood control analyses and impacts of alternatives on Dead Horse Island).

- In fluvially-dominated tidal systems, elevations become critical for planning ecosystem restoration. DWR needs to identify geometric and elevation relationships between:1) interior of subsided and non-subsided portions of MWT, Staten, Dead Horse, and adjacent Islands, Tracts; 2) river and slough channel bathymetry; 3) levee top elevations; 4) local tidal datum range; 5) modeled flood stages at a range of recurrence intervals. Quantification of these relationships is needed to help assess what processes are likely to occur and resulting ecosystem function, as well as the feasibility of various alternatives.

- In order to assess the potential for ecosystem restoration, high quality information is needed on special status species in the North Delta. These surveys need to be assembled and analyzed. Where information is lacking, surveys need to be conducted.

- Exotic plants and animals are a significant concern for the North Delta. To date, there has been no comprehensive analysis of the state of invasives in the North Delta. Additionally, strategies need to be developed to encourage natives and discourage exotics.

- If dendritic tidal channels are a goal of the MWT restoration, then the panel recommends that DWR utilize the tidal gradient at MWT and full tidal exchange to allow tidal channels to self-organize, without engineering intervention—tidal channels will be oriented toward the lower breach, not toward Mokelumne River. Because the transition between intertidal and supratidal/ fluvial depend on interactions between the Mokelumne River and Camanche dam flows, the Cosumnes River, and flows through the Delta Cross Channel, a combination of modeling and geomorphic analysis is needed to investigate the process-function relationships possible under different restoration scenarios.

- Mercury methylation and bioaccumulation was not discussed during the panel meeting, but will be taken up at a future meeting. However, several panel members suggested investigating the role of coarse sediment deposition as a possible mechanism to minimize meHg.

SUMMARY

The panel was generally positive about the potential ecosystem restoration benefits of the NDIP, and was supportive of DWR staff's efforts on this complex project. Most panel members felt that rather than optimizing flood control and ecosystem restoration, the flood control objectives appear to be driving the project at this point. The project would benefit from a systematic evaluation of the flood control and ecosystem benefits of a greater range of alternatives. This evaluation would test all project alternatives equally against project objectives.

The panel identified a range of critical uncertainties that will need to be addressed through targeted research, development of process-response models, and adaptive management. These uncertainties will be addressed more specifically in the next panel meeting to be scheduled in the new year.

Attachment 1

Panel Next Steps

It was recommended that the Panel reconvene in January or February for a second meeting. The one-day meeting would be structured to address key uncertainties identified in the first meeting. The first two hours of the meeting would be spent reviewing "global" issues that have arisen, including answers from DWR to our criticisms or suggestions. Then, from 10-3, specific groups would break out and work with DWR staff to discuss critical specific issues and how they might address them through experiment and analysis. The subgroups would refine the questions that need to be addressed, identify what output is needed from existing models, define metrics to measure or predict ecosystem response, and develop recommendations on how to tackle larger scientific issues. At the end of the day the whole group will reconvene, with each break-out group summarizing their recommendations, answering questions from the rest of the panel and integrating the conclusions of the subgroups. Subgroups (with some overlap) would include:

- Water Quality—addressing DOC, Hg, food web support
- Ecology—fish, exotics, riparian forests, ecosystem responses
- Hydrology--hydraulics, hydrology, geomorphology

The third and final meeting of the science panel would include evaluation of the outcome of DWR's incorporation of recommendations into planning process.

The following is a list of questions provided to the Science Panel prior to the November 13th meeting. These questions will help guide the second meeting.

Panel Questions

<u>General Questions</u>

- How can the model of "what would the system it revert to without constraints" be incorporated into the project planning process so the project can restore natural processes?
- How will conceptual models be assessed?
- Why can't do ecosystem rest at MW with no change in flood control?
- Why are there 4 alternatives for Staten and only one for MW—what are viable ecosystem restoration alternatives besides variance in levee breach width?
- Are these the right alternatives to optimize both flood control and ecosystems restoration?
- Is the Benson ferry target driving the need to use aggressive flood control measures in MW instead of looking at the criteria needed for ecosystem restoration?
- Is there time to do proposed demonstration projects before EIR process begins?
- Are previous ecosystem alternatives modeled by UCD being considered? If not, why not?
- Why is 2-ft reduction at Benson's Ferry target?

Attachment 1

- What is the ecological, economic benefit of the proposed Dixon channel? Why do Dixon channel at all?
- Why lower stage upstream of MW if it is potentially growth inducing?

Hydraulics-Hydrology-Modeling-Design

- How much control does anyone have over Camanche releases—and how could that uncertainty affect the project?
- How long do floods last (duration, stage)?
- What is the duration of flood reversals?
- What is the minimum threshold for floods—e.g. what is minimum threshold (magnitude, timing, duration, etc) to show have met ecosystem restoration goals?
- How much does future development potential affect hydrology, e.g potential Morrison creek urbanization will increase stage?
- How much has storage capacity been reduced by new levees around urbanizing areas south of Sacramento?
- Do flood targets consider duration of flow at high and low magnitudes?
- What is flood recurrence interval that would overtop east levee?
- What is conveyance of the Mokelumne River channels without flow through at MW?
- Are there are other ways to get flood flows through MW?
- Does dredging increase conveyance and if so, how much does it reduce flow stages?
- How does dredging below sea level increase flood conveyance?
- If lower MW is open and MW is full of water, is degradation of east levee needed to eliminate surge?
- Are new levees required for flood storage on Staten a new threat to downstream areas on the island—if new Staten levee overtops e.g. would there be the same surge as there currently is on MW when the east levee fails accidentally?
- At what stage will detention basins start being filled?
- How long would water be stored?
- Are setback levees being considered?
- Why maintain levees around MW at all if the downstream end will be open anyway?
- What are the trade-offs between setback levees and detention basins for flood stage reduction?
- Why excavate the channel through Dixon instead of simply letting flood water over flow onto this floodplain area and re-create a riparian forest?
- Is flood energy enough to scour out interior of MW without excavation of channels?
- If diverted water into MW through the Mokelumne River instead of the Dixon channel what would happen?
- How far could levees be degraded and still dampen fetch?
- What alternatives are there for the kind of feature that could modify fetch related erosion at New Hope Levee?

Attachment 1

- Does water get through proposed Dixon channel any faster than it already does by way of Middle Slough?

Ecology-Fish-Exotics

- What are the fish stranding issues associated with the detention basins?
- How does flow duration govern what vegetation survives there?
- How would exotics like arundo donax and pepperweed be kept out of the proposed Dixon channel? How will the project mitigate for new exotic plants?
- Can get fish out of the proposed Dixon channel through culverts?
- How does the project support special species habitat? Will be predators from deep
- subtidal zone enter into the intertidal and fluvial zones?
- How can self sustaining habitat be restored at MW and Dixon?
- If lower MW becomes full of exotics, why keep production there? Why produce for exotic species?
- Are "natural" relationships between natives and water depth affected by the presence of predators in this currently disturbed system? What are the implications for restoration?
- What is the best way to minimized mosquitoes problems?
- How will ecological responses to physical structural system built be assessed?
- What hydrologic residence time is important to get the maximum productivity, are there negative effects of increasing residence time at MW?

Water quality

- What are the water quality issues associated with the detention basins?
- If demonstration projects that are already 4 years old haven't reached steady state—how can predict long-term DOC and carbon cycling at restored MW through demonstration projects?
- Are water quality effects and exotics issues that will prevent implementation of the project, or do food web or other benefits outweigh these issues?
- How will increased residence time of sediment, water in a restored MW affect DOC?
- How does groundwater flow affect DOC?
- Will the meHg problem reduce over time as the system traps coarse sediment and reverts to floodplain?
- What is needed to promote salinity regime required by North Delta habitat?

Geomorphology-Sediment

- Would Dixon channel help get sediment into Dixon floodplain and MW?
- Does excavating sediment from MW deplete sediment in storage at the expense of new channel formation (formed by splay channel aggradation and progradation)?
- Is system sediment limited?

Attachment 1

- What is the volume of material needed in the various alternatives (for individual elements) and what are alternative sources of that sediment? e.g. how much sediment would not building islands save from the need for excavation?
- What would hybrid tidal-fluvial channel look like?
- Is a hybrid tidal-fluvial channel possible and would it persist?
- What recurrence interval of flood would “blow-out” tidal morphology in MW?
- Can the system get both functional tidal and fluvial processes or is it a trade-off? What is the optimal plan for floodplain and optimal plan for tidal habitat? What is the desired function/habitat as MW fills in, e.g. in 30, 50 years?
- What processes would dominate the system in the absence of intervention?
- Why remove lower levee down to grade if that would just allow sediment to be flushed from site?
- Can tules help retain sediment? How much?
- Under what scenarios could channel migration in the Mokelumne occur; e.g. would the levee have to be removed, or would there have to be a true avulsion event with new channel formation?
- Could Middle Slough be integrated into the alternatives to re-create multiple channels that once dominated morphology?
- How many breaches optimize habitat potential?
- Where should breaches be placed—what criteria are applied to select breach openings?
- What is hydrologic (tidal and flood) and hydraulic difference between placing breaches in the Mokelumne River, vs. in Snodgrass Slough?
- What are the potential effects of a fully tidal vs. modified tidal range on restoration of sustainable physical processes and habitat at MW?

Attachment 2

NORTH DELTA SCIENCE PANEL MEETING IV
GRIZZLY SLOUGH ECOLOGY
JANUARY 2005
Science Panel Summary

Introduction

This document summarizes discussion at the forth North Delta Science Panel meeting held on January 27, 2005 at the University of California, Davis (UCD). The goals of the forth North Delta Science Panel meeting were focused specifically on Grizzly Slough, and included: 1) an update of geomorphic assumptions used order to develop conceptual restoration alternatives for the Grizzly Slough Tract; and 2) a briefing of ecological considerations.

During the January meeting, project background information revised conceptual alternatives were presented by Department of Water Resources (DWR) staff and Philip Williams Associates (PWA), and Environmental Sciences Associates (ESA) consultants to DWR. The science panel present included:

Peter Moyle, Professor, UCD—Fisheries and Wildlife Biology
Sharon Lawler, Professor, UCD—Entomology
Wendy Trowbridge, Post-doc, University of Nevada, Reno
Jeff Mount, Professor, UCD—Geomorphology, <u>Science Panel Chair</u>
Joan Florsheim, Research Scientist, UCD—Geomorphology, Science Panel Coordinator

This document provides a summary of key panel recommendations and considerations to aid DWR in their planning efforts. The recommendations are based on the panel's research experience in the North Delta including the Cosumnes, Mokelumne, and Dry Creek Rivers, the area including Grizzly Slough, and on issues raised previously by the 13 member North Delta Science Panel during the first two North Delta Science Panel Meetings and the Hydrology and Geomorphology Panel subset during the third meeting focused on Grizzly Slough.

Attachment 2

Summary of Panel Ecology (and Hydrology and Geomorphology) Findings and Recommendations

During the January meeting, the science panel questioned assumptions related to Grizzly slough ecology, hydrology and geomorphology and posed three fundamental questions in order to help focus restoration options:

- Could the proposed project restore tidal freshwater marsh environment?
- Could the proposed project potentially restore floodplain processes?
- Could the proposed project potentially sustain floodplain ecology?

The panel suggests that the Grizzly Slough Tract is appropriate for fluvial process and riparian restoration; even through the lower part of the site is tidally influenced.

<u>Potential Restoration of Tidal Freshwater Marsh</u>

The Grizzly Slough Tract is within the zone of tidal influence, where water in low elevation sloughs adjacent to the site is subject to tidal stage fluctuation. However, fluvial processes near the confluence of Dry Creek and the Cosumnes River are likely to dominate geomorphic processes such as flooding, erosion, and deposition.

The panel considered the feasibility of creating tidal freshwater marsh habitat at the site and suggested that because of the distance of the site upstream of the Delta, tidal freshwater habitat could not be achieved without significant grading. Instead, the tidal influence at the Grizzly Slough site is likely to be manifested as variation in low flow water levels (over an approximately 2-foot tidal range) similar to the stage variation in the Cosumnes River channel adjacent to the Cosumnes River Preserve. However, this tidal fluctuation would not drive processes in this fluvial-tidal transition zone. Thus, the panel recommends that sustainable ecosystem restoration is most suited to fluvial-riparian habitat.

Questions arose related to the effect of tidal influence at lower end of site with respect to mosquitoes and exotic fish. The panel suggested that mosquitoes are not likely to be a big problem as the upper part of the site will dry out during the warm summer months. However, if ponded areas persist into late spring (April-May), *Anopheles freeborni* mosquitoes may begin to breed appreciable numbers. Tidal exchange in the lower part should minimize mosquito problems. Some maintenance may be required to encourage tidal flushing or to reduce dense stands of emergent vegetation where mosquitoes can thrive. Areas with tidal influence would be dominated by non-natives in summer as it is everywhere in the Delta; however, winter and spring conditions would bring native fishes to the site.

Attachment 2

Restoration of Floodplain Processes

Modification to the conceptual restoration designs based on recommendations from the December 15 Science Panel meeting show a branch of Dry Creek routed across the Grizzly Slough tract from east to west with various options for levee removal utilize the existing gradient and provide opportunity for restoration of floodplain processes. The panel felt that this configuration addressed issues raised at the December meeting. Questions remaining (e.g. would a channel form without excavation?; would an excavated channel fill in with sediment?; would breaches promote sand splay development? Would an excavated swale adjacent to the new channel promote riparian establishment? How does the timing of flooding in the Cosumnes and Dry Creek influence fluvial processes?) could be addressed through adaptive assessment and monitoring and potential phasing of the project. A suggestion from the panel was to assume Dry Creek as the source of sediment form splays instead of expecting uncertain transport regime from Grizzly slough to create a splay.

Restoration of Floodplain Ecology

The site contains an appropriate range of elevations to promote restoration of floodplain riparian species. The panel suggested that vegetation management may be required if conditions for establishment of cottonwood and willow are not met during the first year of the restoration project, e.g. if the ground is not flooded at the right time of year, and if the rate of drawdown is so rapid that it isolates roots of seedlings. If riparian species are not established during the first year, bare ground is likely to be overrun with exotics. Disking could be an option to renew "disturbance" required for establishment, however, suitable methods for exotics removal would need to be reviewed with relevant agencies. Questions related to succession potential that depend on disturbance regime or recruitment from upstream areas could be addressed through adaptive assessment and monitoring. The lowest portion of the site within the tidal range is likely to be dominated by Scirpus and slightly higher areas by annual grasses. The range of tidal inundation and associated plants is likely to shift during the next several decades due to global warming and sea level rise.

Key Habitats and Species
Key habitats that could be promoted through restoration of the Grizzly slough site include seasonal floodplain with primary successional riparian vegetation. Native species that would benefit most from the proposed conceptual restoration design would be chinook salmon, splittail, minnows, sandhill cranes, and Swainson's Hawk.

Regulatory Issues
The proposed conceptual designs would not be a detriment to any species of concern.

Mowing is generally not an option due to potential harm to giant garter snake. Note that if the site was maintained as an agricultural area, disking and harvesting would be allowed.

Attachment 3

North Delta Science Panel Members

Topic	Scientist	Affiliation	Expertise
Geomorphology	Jeff Mount	UC Davis	fluvial processes, restoration
	Joan Florsheim	UC Davis	fluvial and tidal processes, restoration
	Denise Reed	Louisiana State University and Ecosystem Restoration Program Independent Science Board	tidal processes, restoration
Hydrology and Hydraulic Modeling	Geoff Schladow	UC Davis	
	Bill Fleenor	UC Davis	
	Jon Burau	U.S. Geological Survey (USGS)	
Fish/Aquatic Biology	Peter Moyle	UC Davis and Ecosystem Restoration Program Independent Science Board	Bay-Delta fish biology
	Bill Bennett	UC Davis	Delta smelt
Ecology and Exotics	Dennis Murphy	University of Nevada and Ecosystem Restoration Program Independent Science Board	terrestrial ecology
	Lars Anderson	UC Davis	aquatic ecology
Water Quality	Randy Dahlgren	UC Davis	nutrients
	Roger Fujii	US Geological Survey	organic carbon
Mercury	Mark Marvin DiPasquale	US Geological Survey	
Mosquitoes	Sharon Lawler	UC Davis	vector research